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# IMPLICATIONS OF DIURNAL WARMING EVENTS ON ATMOSPHERIC MODELLING

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## ABSTRACT

The diurnal variability of SST is recognized as an important mode of variability that modulates air-sea interaction processes with direct impact on the heat and gas fluxes. With low enough winds and sufficient solar heating, the diurnal warm layer is typically constrained in the upper few meters of the water column and it is most intense within the first few centimeters, since the largest percentage of the infra-red radiation is absorbed there. This is also the part observable by infra-red and microwave radiometers, either mounted on satellites or ships.

The increased availability of SST retrievals from space has lead to the identification of multiple diurnal warming events, occurring at all latitudinal bands in coastal and open ocean conditions. Studies have been performed in order to evaluate the impact of not properly resolving the diurnal cycle in the estimation of surface heat fluxes and the exchange of $CO_2$ between the ocean and the atmosphere. While this impact has been shown to exist at various regions of the world's oceans, most operational atmospheric and oceanic models up to day still do not account for the daily SST variability.

The ESA funded project on the diurnal variability of SST, its regional extend and the implications in atmospheric modelling (SSTDV: R.EX.-IM.A.M.) will be finalized by the end of 2015. During the project, an extended characterization of diurnal warming cases over the Atlantic Ocean, the Mediterranean, Black, Baltic and North Sea took place, based on 6 years of hourly SST fields. Furthermore, a one dimensional ocean turbulence model was used to reproduce diurnal signals identified from in situ measurements at some depth, typically of 1 or 2 m, and those identified by satellite SST. The model showed a very good skill in bridging the depth gap between the surface warming and that occurring some few meters below, even when forced with meteorological variable from an independent numerical weather prediction model.

During the final part of the project, the 10 largest diurnal warming events were identified from the 6 years of available data and for a region covering parts of the North and Baltic Sea. These events mostly occurred in spring and summer and the peak daily anomaly reached up to 8 degrees in some cases. The hourly SST fields retrieved during those events are used as boundary conditions in the Weather Research & Forecasting (WRF) model, thus increasing the temporal resolution of SST in the model from the typical daily SST update. With this mode, the surface wind field and the heat fluxes are modeled and compared to the outputs without the hourly SST update. In addition, 10-meter winds are compared to in situ measurements from meteorological masts and Synthetic Aperture Radar (SAR) retrieved winds, when available. Heat flux estimates are compared to the SEVIRI Surface Solar Irradiance (SSI) and Downward Long-wave Irradiance (DLI) products.